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THE CHOLERA SITUATION.

There has been no material change in the cholera situation during the past week.

NEW YORK.

Vessels Arriving at Quarantine.

Passed Asst. Surg. von Ezdorf reports the arrival, October 13, of the steamship *Sant'Anna* from Marseille, Naples, and Palermo, with 710 steerage passengers and 149 members of crew. Bacteriological examination of all steerage passengers and two members of crew proved negative.

ORIGIN AND PREVALENCE OF TYPHOID FEVER IN FORT SMITH, ARK., AND MEASURES NECESSARY FOR ITS CONTROL.

By W. H. FROST, Passed Assistant Surgeon, Public Health and Marine-Hospital Service.

An investigation into the origin and prevalence of typhoid fever in Fort Smith, of which this is a report, was undertaken in compliance with the wishes of the local authorities by request of the governor of the State.

In this investigation an attempt has been made to collect such information as was available concerning the prevalence of typhoid fever in Fort Smith both during the present year and the last 10 years, and to study the causes of the prevalence of this disease with a view to making recommendations of measures for the removal or diminution of those causes.

In presenting this report I desire to express my very hearty thanks to the mayor and the members of the board of health, especially to Dr. A. E. Harden, the health officer; to Dr. Claxton, city bacteriologist; and to Mr. H. E. Kelly, of the board of improvement, for cooperation and assistance rendered. I desire also to express my appreciation of the courtesies extended by the physicians of the city and of assistance rendered in various ways by numerous citizens.

PREVALENCE.

In order to ascertain the prevalence of typhoid fever in the city during the present year Dr. A. E. Harden, the health officer, sent out to each physician shortly after my arrival a circular letter requesting

an immediate report of all cases of typhoid fever treated since June 1. In reply to this letter 46 cases of typhoid fever were promptly reported. This number does not, however, represent the total number of cases known to have occurred and to have been treated in the city during this period. Altogether 27 cases not reported by the attending physician have been reported from other sources and in most instances verified, making a total of 73 cases known to have occurred since June 1. Of these at least 2 are considered not to have been typhoid fever and may be deducted. Concerning the diagnosis of the remaining 71 cases, while it has been impossible to make a detailed investigation of each case, it is confidently believed that in the great majority the diagnosis of typhoid fever was correct. According to the city records there have occurred in the city since July 1, 5 deaths from this disease in residents of Fort Smith. It seems highly probable, therefore, that the estimate of 71 cases occurring since June 1 is approximately correct, since on this estimate the mortality would be about 7 per cent, which is about the usual mortality rate for typhoid fever.

By comparison with the death records of the city from 1901 to 1910, inclusive, it appears that the prevalence of typhoid fever in Fort Smith during the present year has not been unusual. During this year there have been recorded 12 deaths occurring in the city. Of these, 3 were of nonresidents brought into the city during their illness for treatment. The remaining 9 deaths were among residents of the city. This is equivalent to a rate of 12 deaths among the residents of the city for 12 months. The number of deaths each year since 1901 was as follows: 1901, 8; 1902, 9; 1903, 9; 1904, 9; 1905, 18; 1906, 6; 1907, 14; 1908, 12; 1909, 17; 1910, 14; making due allowance for increase in population during the last 10 years, it is evident that there has been, on the whole, no constant increase in the death rate from typhoid fever during this period.

In the following table are given the death rates in 1900 and in 1910 in several cities whose statistics are at present readily available:

Cities.	Deaths per 100,000 population in—	
	1900	1910
Boston, Mass	24.1	11.6
New York City	20.4	11.7
Philadelphia	37.2	18.0
Richmond, Va	103.0	21.9
Washington, D. C	79.7	24.4
Indianapolis	41.4	29.9
New Orleans	52.6	31.5
Baltimore	38.9	42.0
Atlanta	.....	42.6
Nashville, Tenn	.....	48.0
Charleston, S. C	.....	56.1
Little Rock	47.0	34.8
Fort Smith	[1] 66.0	58.3

[1] For 1901; estimate.

The rate of 58.3 per 100,000 for Fort Smith in 1910 is higher than that of any of the cities named, which may be considered fairly representative of American cities in general. There are of course fairly

numerous other cities in which the rate is even higher, yet such a rate may very justly be considered quite excessive for a city of the size of Fort Smith at the present time. The average death rate in all the registration cities of the United States for 1908 was 25.8 per 100,000. In 40 cities of over 100,000 population, according to the census of 1900 whose statistics are given in the Vital Statistics Report of the Census Bureau for the years 1904–1908, only two had a typhoid death rate exceeding 50 per 100,000 in the year 1908.

Even after making due allowance for the increase in the apparent death rate, due to bringing in cases to local hospitals for treatment, it must still be admitted that Fort Smith has—and for the last 10 years has had—a typhoid death rate which is certainly excessive and is a matter worthy of the most careful consideration. It is probable that not less than 100 cases of typhoid fever occur annually in the city. A most conservative estimate would place the cost of those cases to the taxpayers of the city at not less than $40,000. It is obviously impossible even to attempt an estimate of the distress and suffering entailed.

The necessity for giving careful and immediate attention to the problem of reducing typhoid fever depends, however, not only on the seriousness of the question, but equally on the practicability of effecting a very considerable reduction. From the figures above given it is seen that in practically all cities listed there has been, during the last 10 years, a substantial reduction in the typhoid fever death rate. This is especially notable in Richmond, Va., and in Washington, D. C., and is simply another illustration of what has been repeatedly proven, namely, that typhoid fever is practically, as well as theoretically, a *preventable* disease.

SOURCES AND MEANS OF TRANSMISSION OF TYPHOID FEVER.

Typhoid fever, whenever and wherever it may occur, is always due to one essential cause, namely, the typhoid bacillus or germ of typhoid fever. This germ is a living organism of extremely minute size, so small that it is invisible except when magnified many times with powerful lenses. It is, however, subject to the same laws which govern living organisms in general. Under favorable conditions it multiplies or breeds with amazing rapidity. Under unfavorable conditions it remains quiescent or, if the conditions are sufficiently unfavorable or prolonged, it dies.

When this germ is introduced into the human body through the mouth it may reach the intestines, multiply there, and give rise to the disease known as typhoid fever. *All the evidence available indicates that the human body is the only natural breeding place of the typhoid bacillus.* Wherever else it may be found in nature it may be safely considered to have come recently from the body of an infected person. Outside the human body the germs usually live but a comparatively short while. To this statement, however, there is one important exception: In milk the germs may find a favorable breeding place and multiply very rapidly.

Typhoid bacilli are discharged from the bodies of infected persons in the excretions of the bowels and often those of the bladder. These

discharges are the sole and only source of typhoid fever. Anything which may carry the bowel or bladder discharges of persons infected with typhoid fever to the mouths of other people may spread the disease. The prevalence of typhoid fever in any community is quite strictly proportionate to the chances offered in the community for the contamination of human food and drink with the discharges from the bowels and bladder.

Every person infected with typhoid bacilli is a possible source from which the disease may be carried to others. Infected persons may be classed into recognizable and unrecognizable sources. The most readily recognizable, and possibly the most important, source of typhoid bacilli is the person sick with the disease; the discharges of such persons always contain typhoid bacilli. Unfortunately, there are other important, but practically unrecognizable, sources from which typhoid bacilli may be spread. These are:

1. *Persons in the very early stage of the disease.*—A considerable time, usually from one week to three weeks, elapses between the entrance of the typhoid germs into the body and the development of definite symptoms of the disease. The germs may be discharged from the body for a considerable time before symptoms of the disease are recognized.

2. *Persons recently recovered from typhoid fever.*—A very considerable percentage of typhoid fever patients continue to discharge typhoid bacilli from the bowels and bladder for several weeks after the symptoms of the fever disappear.

3. *Persons long since recovered from typhoid fever.*—A small percentage (estimated at 2 per cent) of people who have previously had typhoid fever continue for years thereafter—often for the rest of their lives—to harbor and breed typhoid bacilli and to discharge them from their bowels or bladder. These people may themselves be in good health and can be recognized as typhoid bacillus carriers only by bacteriological examination of their discharges. It may be safely assumed and has often been demonstrated that any community where typhoid fever has been constantly present has in its midst a considerable number of such persons who mingle unrecognized with their neighbors. These unrecognized, unsuspected carriers are a continual source of infection.

4. *Persons who become temporarily infected with typhoid bacilli without developing the characteristic symptoms of the disease.*—In some cases typhoid bacilli multiply in the body, giving rise to only slight symptoms, the so-called walking typhoid. In still other cases it has been shown that the bacilli may multiply in the body for awhile and be discharged in the excretions without giving rise to any symptoms whatever.

In the prevention of typhoid fever attention must be paid to the unrecognized, as well as the recognized, sources. The bacilli from recognized sources, that is, from persons known to be sick with the disease, may be destroyed as they are discharged, namely, in the sick room. As it is impossible to destroy the germs as they are discharged from the *unrecognized* sources, the prevention of the spread of the disease from such sources consists in so disposing of all human discharges that there may be the least possible chance of their reaching the food or drink of the community.

The means by which human discharges containing typhoid bacilli are carried to other persons are fairly numerous:

1. These discharges may be carried on the hands of persons who handle typhoid-fever patients. Strict cleanliness diminishes the danger of carrying the discharges in this way; but even comparatively clean hands may still carry sufficient traces of infected discharges to cause the disease.

2. Where human discharges containing typhoid-fever germs are exposed, flies may become carriers of the infection and transfer the germs from the discharges to articles of food.

3. Human discharges emptied upon the ground may be washed into wells or streams. Water which may appear perfectly clean and palatable may readily contain a very considerable amount of human sewage, and it has often been known to cause severe epidemics of typhoid fever.

4. Milk may become infected with the discharges of typhoid-fever patients if handled by persons who are themselves suffering with the disease or who have handled typhoid-fever patients. It may also become infected by flies passing from an open privy to the milk pail. A milk bottle may become infected at the house of a typhoid-fever patient and unless properly sterilized before it is refilled its whole contents may become heavily infected. Infection of milk from any source is especially dangerous since, as above stated, the germs may multiply rapidly in milk at ordinary summer temperature.

5. Other, perhaps less important means of distributing typhoid germs, are fruits and vegetables, especially those which are eaten raw or those which after being cooked are handled by many persons or are exposed to flies. In fact, any article whatsoever that is used as human food or drink and is exposed in any way to contamination with human discharges may serve to carry germs of typhoid fever.

CAUSES OF TYPHOID FEVER IN FORT SMITH.

The ultimate sources of typhoid fever are the same in all communities, the carriers of infection varying in relative importance in different communities. In order to determine which carriers have been most important in the causation of typhoid fever in Fort Smith, a personal investigation was made of as many as possible reported cases, altogether 28. Of these 28 cases 4 were found to have originated outside the city, leaving 24 cases in which the disease was almost certainly contracted in or around Fort Smith. Of these 24 cases 5, equal to 20.8 per cent, were almost certainly due to direct contact with previously recognized cases; 7, equal to 29.2 per cent, are considered as in all probability due to infection from other nearby recognized cases either by personal contact or through the agency of flies. Altogether, 12 or 50 per cent of the investigated cases may be considered as due to contact, either direct or through flies, with previously recognized cases.

Concerning the other 50 per cent of cases, no definite cause could be ascribed to the individual cases. Certain facts, however, very strongly indicate that flies have probably played an important part in their causation since it was found that a disproportionate number of the cases were in neighborhoods supplied with open privies or defective water-closets.

Of the 24 cases investigated 15 or 62.5 per cent occurred on premises not connected with a sewer, using open privies for sewage disposal; 6, or 25 per cent, occurred on premises provided with only a yard water-closet. It may be mentioned here that the type of water-closet most generally found in outhouses is extremely objectionable. The closets usually have a narrow, cone-shaped bowl, imperfectly flushed, with the consequence that the sides are almost invariably found more or less contaminated with particles of fecal matter, especially where the enamel has been cracked or worn. Flies, which are usually most abundant when the closets are most filthy, may readily spread infection from such closets. Only 3 of the 24 cases investigated occurred in houses provided with good water closets located inside the house. It is obvious that there has been a very disproportionate prevalence of typhoid fever on premises and in vicinities where human discharges are emptied in privies or yard closets where flies may have ready access to them.

The sanitary conditions on the premises where the investigated cases of typhoid fever occurred were found to be bad in 18 or 75 per cent, fair in 6 or 25 per cent, and good in none. Comparing this with the sanitary conditions of the city generally, where it may be assumed that at least the majority of the premises are maintained in good sanitary condition, it is very evident that typhoid fever in Fort Smith has been closely associated with bad sanitary conditions; and again it may be emphasized that what constitutes a bad sanitary condition is more than anything else the presence of human filth.

In each case investigated inquiry was made as to the precautions exercised to prevent the spread of the disease to other members of the family and to neighbors. These precautions were: *Good*, in none except one imported case, *fair* in no case, *poor* in 10 families with an aggregate of 13 cases, *no precautions whatsoever* in 5 families with an aggregate of 10 cases.

Efficient precautions to prevent the spread of typhoid fever from a recognized case consist in the prompt disinfection or destruction of all discharges coming from the patient, and all articles whatsoever in any way soiled by those discharges. This may be accomplished by very inexpensive means so simple as to be readily carried out by any person of average intelligence when properly instructed. The general neglect of such precautions in the city is due evidently to a lack of proper instruction far more than to indifference in following instructions.

There is no evidence that infected milk has played any recognizable part in causing typhoid fever in Fort Smith during the present year.

The city water supply can hardly be considered as a probable source of infection for the cases investigated, since only 8, equal to 33⅓ per cent, of these cases had used the city water at all for drinking purposes within a month prior to their illness. The rest of the patients had used water obtained from wells usually located on their own or neighboring premises. These wells were, in some instances, deep driven wells; in other instances they were shallow wells subject to the danger of sewage pollution. Some of these cases may have been due to the use of infected wellwater. In the majority, however, it is believed that this was not the source of infection.

From a careful analysis of the cases of typhoid fever investigated and a survey of sanitary conditions generally I am of the opinion that the prevalence of typhoid fever during the current summer and fall has been due chiefly to the spread of infection through open privies and defective water-closets and to the lack of efficient precautions in the care of recognized cases of the disease.

WATER SUPPLY.

During the period of this investigation careful attention has been given to the city's water supply with special reference to the danger of its pollution with human sewage. The source of the city's water supply—the Poteau River—is subject, as are all streams flowing through populated areas, to constant pollution with discharges of persons living upon the watershed. The pollution of the watershed above Fort Smith, so far as may be inferred, is for the most part remote and, compared with other rivers, relatively slight. The river is, however, subject to occasional greater pollution from other sources, namely, from the more highly polluted Arkansas River when the latter at high stages causes a back flow in the Poteau. At such times a still more important source of pollution is the drainage from Mill Creek, which is carried by the back flow in the Poteau directly over the intake for the city's water supply.

In the bacteriologic examination of water it is possible to estimate with reasonable accuracy the total number of bacteria present, which, when carefully considered, gives a valuable index of the probable sanitary quality of the water. It is also possible, and usually of more importance, to estimate roughly the number and proportion of bacteria coming from the intestines of man or the lower animals. It is not practicable, by any bacteriologic methods as at present developed, to distinguish between the ordinary intestinal bacteria of man and those of other animals. It is always necessary, in interpreting the results of the bacteriologic examination of any water supply, to take into consideration the nature of the watershed. The presence of intestinal bacteria in the water of a river which drains a sparsely populated grazing country is less significant of dangerous pollution than the presence of an equal number of sewage bacteria in the water of a river draining a thickly populated area or directly receiving the sewage of a city.

Bacteriological examinations have been made of the following samples of water:

1. From the Poteau at the city's intake, 8 samples.
2. From the Poteau about 200 yards above the city's intake, 3 samples.
3. From the Arkansas River just above the mouth of the Poteau, 3 samples.
4. From Mill Creek just above the mouth of the Lower Branch, 8 samples.
5. From the Town Branch, which carries the drainage of the area for which it is proposed to construct a storm sewer, 6 samples.
6. From a city tap, 11 samples.

The results of these examinations are given in detail in the tables following.

Water from—	Date of collecting samples.	Total number bacteria per cubic centimeter.	Quantities in which the colon bacillus was demonstrated.[1]				Estimated number of colon bacilli in 10 c. c. of the sample.
			5 c. c.	1 c. c.	0.1 c. c.	0.01 c. c.	
Poteau River at city intake	Sept. 9	1,450	+	+	+	.....	100
	Sept. 11	1,675	.....	+	+	.....	100
	Sept. 12	500	.....	+	+	.....	100
	Sept. 13	900	.....	+	−	.....	10
	Sept. 14	(2)	.....	+	−	.....	10
	Sept. 15	350	.....	+	−	.....	10
	Sept. 18	440	.....	+	(?)	.....	10
	Sept. 20	2,325	.....	+	+	.....	100
Average	.....	1,087	.....	.....	.....	.....	55
Poteau River above intake	Sept. 13	800	+	−	−	.....	2
	Sept. 14	(2)	.....	−	+	.....	10
	Sept. 15	300	.....	+	−	.....	10
Average	.....	550	.....	.....	.....	.....	7.3
Mill Creek	Sept. 9	5,000	+	+	.....	.....	100
	Sept. 11	4,250	.....	+	−	.....	100
	Sept. 13	2,500	.....	+	+	.....	1,000
	Sept. 14	(2)	.....	−	−	.....	(?)
	Sept. 15	375	.....	−	−	.....	0
	Sept. 18	265	.....	.....	.....	.....	10
	Sept. 19	100,000	.....	+	+	.....	1,000
	Sept. 20	6,300	.....	+	+	.....	1,000
Average	.....	16,950	.....	.....	.....	.....	458
Town Branch	Sept. 9	10,000	+	+	.....	.....	100
	Sept. 11	4,500	.....	+	+	.....	1,000
	Sept. 13	14,250	.....	+	−	.....	100
	Sept. 14	(2)	.....	+	−	.....	100
	Sept. 19	100,000	.....	+	+	.....	1,000
	Sept. 20	26,000	.....	+	+	.....	1,000
Average	.....	31,000	.....	.....	.....	.....	550
Arkansas River, above mouth of the Poteau.	Sept. 11	2,525	.....	+	+	.....	100
	Sept. 12	14,500	.....	+	+	.....	100
	Sept. 20	6,000	.....	+	+	.....	100
Average	.....	7,675	.....	.....	.....	.....	100
City tap, at laboratory	Sept. 9	475	+	−	−	.....	2
	Sept. 10	610	+	+	.....	.....	10
	Sept. 11	200	+	+	.....	.....	10
	Sept. 12	310	−	.....	.....	.....	0
	Sept. 13	535	+	−	.....	.....	2
	Sept. 14	(2)	+	+	.....	.....	10
	Sept. 15	275	+	−	.....	.....	2
	Sept. 17	510	+	−	−	.....	2
	Sept. 18	320	+	−	.....	.....	2
	Sept. 19	260	+	−	−	.....	2
	Sept. 20	630	+	+	.....	.....	10
Average	.....	412	.....	.....	.....	.....	4.7

[1] Demonstration of B. coli consisted, in application of "presumptive" test, namely, gas formation in lactose-bile.
[2] Not estimated.

These examinations may be summarized as follows, giving an approximate idea of the relative bacteriologic quality of the samples from the various sources:

Source of samples.	Number of samples examined.	Average number of bacteria per cubic centimeter.	Average number colon bacilli (sewage bacteria) per 10 c. c. (very rough estimate).
Arkansas River	3	7,675	100.0
Mill Creek	8	16,950	450.0
Town Branch	6	31,000	550.0
Poteau at intake	8	1,090	55.0
City tap	11	412	4.7

The bacteriologic examinations, so far as they go, confirm the inferences which would necessarily be drawn from a sanitary survey of the watersheds of the several streams, viz:

The Poteau is a moderately polluted stream. The Arkansas is more highly, but not extremely, polluted.

Mill Creek and the Town Branch are both extremely polluted with intestinal discharges, especially after heavy rainfall. This is to be expected, as the pollution of these streams comes largely from surface washings. The recorded examinations of the samples from Mill Creek show a progressive decrease in the numbers of bacteria and sewage bacteria from September 9 to 18, a dry period, with a sudden great increase on September 19, following a considerable rainfall. Immediately after a heavy rainfall both Mill Creek and the Town Branch undoubtedly carry even larger numbers of sewage bacteria than indicated by these examinations, since the methods used were not adapted to estimating numbers exceeding 1,000 colon bacilli per 10 c. c.

The three days' sedimentation which the river water undergoes in the settling basins before being distributed to the city has effected an average removal of something more than 50 per cent of bacteria and a little over 90 per cent of the sewage bacteria, as well as may be estimated from so few examinations. Even this altogether inadequate purification can not be relied upon as constant, especially so long as the present practice is continued of pumping unsettled river water into the mains in case of fire.

The turbidity of the samples taken directly from the Poteau has varied during the period of observation from 150 to 300 (standard silica scale); water from a city tap from 120 to 280. Very little clarification takes place in the settling basins, owing to the fact that the particles of mud are so very minute as to remain almost indefinitely in suspension. The turbidity of two samples from the Arkansas was approximately 5,000 on the same scale, but the particles were coarser and settled out much more rapidly.

The present water supply of Fort Smith must be considered objectionable both for esthetic and sanitary reasons. The excessive turbidity of the water, rendering it repulsive in appearance, is of itself a serious objection. Quite aside from any consideration of safety, few people who can afford to do otherwise will drink the water of the Poteau River as at present supplied to the city. Very many use household filters, which, in addition to being highly inconvenient, can hardly be considered safe. Still others prefer to use well water, of more pleasing appearance but often far more dangerous than the city water.

The usual and unavoidable sewage pollution of the Poteau from the watershed above Fort Smith is not excessive as compared with the pollution of many other rivers utilized as sources of city water supplies. Since the greater part of this pollution enters the river many miles above Fort Smith, the natural purification processes reduce it very greatly before the water reaches the city. Undoubtedly, however, the degree both of pollution and of natural purification varies widely, so that while the water at Fort Smith may be for long periods comparatively safe, it is undoubtedly at other times fairly highly polluted from sources above Fort Smith. Seldom, if ever, even under the most favorable conditions, will the natural

water of the Poteau be of the quality commonly accepted as "safe" for drinking purposes.

More dangerous even than the constant pollution from sources above Fort Smith is the occasional much greater pollution with sewage from a part of Fort Smith and its vicinity draining into Mill Creek. The water of Mill Creek, carrying a very considerable amount of sewage, may readily find its way into the city intake at times when the Poteau is stagnant or when there is a back-flow from the Arkansas. Under unusual conditions, such as low water in the Poteau, stagnant or with a slight back-flow, and high water in Mill Creek as the result of local rains, the pollution of the city water supply might readily become very great and extremely dangerous to health. A severe epidemic of typhoid fever might result. In fact, sooner or later, if the present water supply of Fort Smith is maintained unprotected, there will almost certainly come a combination of conditions resulting in a water-borne epidemic of typhoid fever.

To render the water supply of Fort Smith safe and satisfactory it will be necessary to protect the intake so far as possible from pollution and to provide purification processes sufficient to remove the unavoidable pollution. Although the modern methods of water purification have reached a high degree of efficiency they are not perfect; and it must be emphasized that, so far as possible, the source of water supply must be protected from sewage pollution. The purification processes should be relied upon only to remove such pollution as unavoidably enters the source. The pollution which can be avoided is pollution with the sewage carried by Mill Creek.

Removal of the intake farther up the river would not satisfactorily protect it, since the back-flow of the Arkansas at times extends many miles up the Poteau, farther than it would be practicable to carry the intake.

To adequately protect the intake it would be necessary to divert Mill Creek to the Arkansas below the mouth of the Poteau or to build a dam above Mill Creek and below the intake. The choice between these two methods is an engineering problem. As to their relative cost or practicability I need express no opinion. The dam, if practicable, offers certain other advantages in addition to protecting the intake from Mill Creek drainage. It would form a settling basin in which the natural processes of purification would diminish the pollution received from sources higher up; it would be a safeguard against deficiency of water in excessively dry seasons. Finally it would exclude the water of the Arkansas River and to that extent simplify the processes of purification. The Arkansas River is much more muddy than the Poteau and its water is, moreover, very different chemically, so that purification processes adapted to the treatment of Poteau water would have to be considerably modified to satisfactorily purify water from the Arkansas.

A dam above Mill Creek, if found practicable by competent engineers, is recommended as the best means of protecting the intake from sewage pollution. When so protected the water of the Poteau can be readily clarified and rendered safe for drinking purposes.

On account of the very considerable amount of mud in the Poteau and the extreme fineness of the particles, the use of chemicals for "coagulation" will be a necessary part of any satisfactory purification process. If the application of the chemicals is under the proper

competent supervision there is no reasonable ground for objection to their use. The choice of chemicals and regulation of their amounts will have to be determined by experiment.

Filtration with the use of a coagulant is recommended as the safest and most satisfactory method of purifying the water. A properly constructed filtration plant operated under competent supervision may be confidently expected to give a safe and satisfactory effluent.

The construction of a filter plant is, however, a matter which would necessarily require a considerable period of time, hardly less than one or two years. It is indeed advisable that the planning and construction of such a plant, though started immediately, should not be undertaken hurriedly or unadvisedly. To protect the water supply in the meantime the following measures are recommended:

That a coagulant be used in the present sedimentation basins to clarify the water. The apparatus necessary for this process has already been installed at a very slight expense. It is believed that by the proper application of this process the water can be rendered clear and its bacterial content very greatly reduced. As an additional safeguard, a temporary substitute for filtration, it is recommended that hypochlorite of lime be applied to the water after sedimentation. It is suggested that this might be done most effectively at the weir between the second and third basins. The apparatus necessary for the application of hypochlorite of lime could be installed at almost negligible expense, and the cost of material thereafter would be very slight. The application of coagulant and hypochlorite of lime should, however, be undertaken only under the constant supervision of a competent chemist conversant with the methods of water purification. Such processes require constant adjustment to meet changing conditions and constant studies of the water before and after treatment to indicate the necessary changes and the efficiency of the processes. It is believed that a very great improvement in the city water supply, rendering it reasonably safe, can be made by these processes, which may, without considerable expense, be put into operation within a few weeks at most; and it is most urgently recommended that they be adopted.

It is hardly necessary to add that the present practice of pumping water directly from the river to a standpipe and turning the water from this standpipe into the city mains at every fire alarm is most unqualifiedly condemned and should by all means be discontinued. It would be worse than folly to continue this practice after the purification process above recommended has been put into operation. The standpipe should either be supplied with water from the third sedimentation basin—the same water supplied to the city—or else its use should be abandoned altogether. From such information as has been given me it would seem a comparatively simple and inexpensive matter to so connect the standpipe as to pump water to it from the sedimentation basin instead of from the river.

MILK SUPPLY.

No problem in the sanitation of a city offers greater difficulties or calls for more constant vigilance than such supervision over the milk supply as will render it free from the danger of introducing typhoid

fever and other infectious diseases. The efforts of the health authorities of Fort Smith to improve and to safeguard the milk supply are thoroughly appreciated and commended. There remains, however, much to be done in this direction before the milk supply of the city can be considered safe.

It is beyond the scope of this report to go into all the details of measures which should be enforced to insure safe milk. For the prevention of milk-borne typhoid fever it is necessary that inspection of the dairy farms should be rigid and performed at short intervals, so that any cases of suspicious illness may be at once reported and properly isolated. Attention should be paid to the sewage disposal on all these farms. Regulations prohibiting the disposal of human discharges on dairy farms in such manner as to offer any chance of contaminating the milk through any agency should be strictly enforced.

In order to insure cleanliness of the milk, bacteriological standards should be adopted and enforced in addition to the chemical standards of purity already enforced. These standards should be made so rigid as to require the utmost care on the part of dairymen to enable them to meet them, but should at the same time be reasonable.

In order that the dairyman may produce the best possible quality of milk a dairy inspector should be provided, whose duty it would be to pay frequent visits to all dairies; at first, to instruct the dairymen in the methods necessary to produce clean milk, and after instruction to see that these methods were rigidly followed. To perform these duties efficiently would require all the time of one man. The health officer, with his many duties, should not be required to make these inspections personally.

In spite of the utmost precautions there always remains some danger of a milk supply becoming infected with the germs of typhoid fever or other diseases. Efficient pasteurization destroys such germs without injuring the milk. It is recommended that pasteurization of milk supplied to the city be especially encouraged. Pasteurization, however, may be relied upon only when it is under strict supervision, when constant bacteriological examinations indicate that it is efficiently done, and when the subsequent handling and bottling is done under the strictest sanitary precautions. Milk after pasteurization is quite as susceptible to contamination with disease germs as is raw milk. Its handling and distribution, therefore, should be under supervision equally as rigid in all respects.

SEWAGE DISPOSAL.

When a city has been supplied with safe water and every possible safeguard thrown around the milk supply, there will still remain much to be done toward the prevention of typhoid fever. Protection of the water and milk supply will do much to prevent the introduction of typhoid fever into the city from outside sources. There will remain, in spite of this, numerous sources of infection within the city, requiring constant and vigilant supervision.

It is of the greatest importance for the prevention of typhoid fever to make provision for the disposal of all human discharges in such a way that they can not reach the food or drink of persons. To this end the discharges must be kept off the ground; otherwise they will pol-

lute the wells and may become scattered in other ways so as to spread the disease. They must, further, be absolutely protected from flies, chickens, and any other carriers.

These objects can be accomplished by providing a sewerage system serving every house in the city and a sanitary inspection force sufficient to see that proper connection with the city sewer is made and maintained at every house. As a temporary substitute where sewer connection is for the present impossible the use of a sanitary privy should be enforced. At a very small expense the insanitary open privy in almost universal use can be made water-tight, fly-proof, and reasonably safe.

It is considered that no measure for the prevention of typhoid fever is of greater importance than immediate attention to proper sewage disposal in every part of the city. A very cursory survey of the city has shown a great number of residences in districts long supplied with sewers still unconnected with the sewerage system and using open privies. In some instances this is said to be due to the fact that the city water has not been supplied to these districts. Wherever this is so it should be remedied, and wherever sewer connection is possible it should by all means be rigidly enforced.

As a preliminary to enforcing sewer connections and the construction of sanitary privies it is recommended that a systematic sanitary survey be made as early as possible and that such inspection be constantly maintained as will serve to keep the health authorities informed of the sanitary conditions of every block in the city. A sanitary survey of the whole city and the enforcement of proper sewage disposal is of especially vital importance for that part of the city whose surface drainage goes into the Poteau River through Mill Creek. It is to this section of the city that attention should first be directed in following out the above recommendations.

With regard to the construction of a storm sewer to drain that section of the city between Little Rock Avenue, Dodson Avenue, South Nineteenth Street, and the Poteau River, the importance of this sewer from a sanitary standpoint would appear to have been considerably magnified. The sewer as contemplated would empty into a small stream which in turn empties into Mill Creek. The effect of this sewer should be undoubtedly to improve the area through which it passes; to carry from this area more water and to carry it more rapidly. In proportion as it does this it will increase the volume of water entering Mill Creek.

While the area through which it is proposed to build this sewer is already provided with a sanitary sewerage system, a storm sewer would under existing conditions carry a considerable amount of human sewage, since there are many residences in this area not connected with a sewer, but using privies, allowing the discharges to be emptied on the ground. The surface drainage of this area is therefore polluted not only with the washings from stables and dirty streets, but also at present with human discharges from many privies. This drainage now finds its way through an open branch into Mill Creek and may consequently, under suitable conditions, find its way into the city water supply, constituting a grave danger to the public health. The increase of this danger through building a storm sewer in this section would not perhaps be very great and yet would not be negligible.

It is believed that the health of the city may best be protected by deferring the construction of this sewer, certainly until universal sewer connection has been rigidly enforced throughout the whole district which would be drained. It should preferably be deferred until the measures recommended for the protection of the water supply have been put into operation. It is believed that the use of this coagulant and hypochlorite of lime for the purification of the water supply would more than counterbalance the additional pollution carried to the intake in consequence of the construction of this sewer.

To summarize the recommendations in regard to the disposal of sewage, they are:

1. To make a complete sanitary survey of the city, reporting to the health authorities all premises not properly connected with a sewer.
2. To enforce sewer connections wherever they are at present possible.
3. Where sewer connections are not at present possible because of a lack of water supply, to extend the water system immediately to those districts.
4. In unsewered districts to enforce the abolishment of all open privies, to be replaced by water-tight, fly-proof privies of construction approved by the board of health, the can of these privies and disposal of their contents to be under the constant supervision of the health authorities.
5. To defer the construction of a storm sewer on the south side until universal connection with a sanitary sewer has been enforced in the entire area drained and until measures have been taken for the protection of the water supply from pollution by the drainage of Mill Creek.

Attention is called to the fact that these recommendations in regard to sewage disposal call for no large expenditure; that they may very easily be put into immediate operation with insignificant expense; and it is confidently believed that they will result in a most substantial reduction of the prevalence of typhoid fever.

OTHER IMPORTANT FACTORS.

Another matter to which attention should be constantly directed is a campaign for the extermination of flies. The most effective means for reducing the number of flies in a community is by excluding them from their breeding places. Their chief breeding places in the city are stable manure and garbage. Regulations requiring all stables to be kept clean and the manure kept in tightly covered fly-proof bins, and requiring all garbage to be kept in suitable tightly closed receptacles, would effect a wonderful reduction in the number of flies in a single season. To reduce the number of flies is not only to remove a serious nuisance, but to reduce the chances for the spread of typhoid fever and other diseases. The enforcement of these regulations and of such others concerning the cleanliness around premises as to effectively prevent the breeding of flies could only be accomplished by constant inspections and rigid supervision.

It was frequently noted in the city that foods exposed for sale, such as fruits and vegetables which are eaten raw, were inadequately

protected against flies. This is also a matter which should receive careful attention. I am informed that there is at present on the statute books a regulation requiring the screening of such foods. If so, it needs only to be enforced.

All restaurants and other places serving food to the public should be required to conform strictly to regulations drawn up by the board of health and should by rigid inspection be kept up to a high sanitary standard.

Finally, but perhaps most important of all for an immediate reduction in the prevalence of typhoid fever, the most rigid precautions should be exercised in the disinfection of all discharges from every known case of the disease. Heretofore this matter has been left altogether to the attending physicians. Some of these are doubtless as careful as possible; others, unfortunately, neglect to inform the attendants fully as to the necessary precautions and to insist upon their being carried out. Supervision over the preventive measures used in the treatment of a case of typhoid fever is just as truly a duty of the health department as similar supervision in the treatment of smallpox and is, in Fort Smith to-day, much more vital to the conservation of the public health.

Effective preventive measures will be universally carried out only when the health department receives prompt notice of every case occurring in the city and sends its representatives to give instructions in the necessary precautions and to see that they are carried out. The fact that 50 per cent of the few cases investigated in the city this summer were traceable with reasonable certainty to infection with previous cases is quite sufficient to demonstrate the importance of these preventive measures.

The further fact that in only one case investigated in the city outside the hospitals were efficient preventive measures being carried out is sufficient to indicate the urgent need of some supervision by the health department.

In order to carry out the measures as recommended in regard to the safeguarding of the milk supply, the sewerage system, the disposal of garbage and manure, and the prevention of typhoid fever from known cases, it is obviously necessary that the health department of the city should be greatly enlarged and strengthened.

The functions of the health department in a city are threefold:

1. Such a department needs to carefully and constantly study the causes of disease. For this purpose it should have accurate and readily available records of the general sanitary conditions of every section of the city, and should have a sufficient force of inspectors to keep this information up to date. It should receive from every practicing physician an immediate report of every case of infectious disease in his practice. The collecting of reports of infectious diseases by the health officer is of itself a task requiring much tact and constant vigilance.

In order to encourage such reports, every aid should be offered by the health department to the physician of the city in the diagnosis of infectious diseases. This is especially true as regards typhoid fever in a community where malaria commonly prevails. The distinction between typhoid fever and malaria in the early stages of illness is often very difficult. The diagnosis can be greatly facilitated by laboratory examinations such as it is not practicable for the average

practicing physician to make. The expense of having such examinations made by a bacteriologist not in the public service is a serious item to people of restricted means. It is now generally recognized as one of the functions of a municipal health department to render aid to the physicians in the early diagnosis of infectious diseases. The laboratory already maintained for such purposes has made a good start in this direction, and deserves such cooperation from the physicians and such liberal support from the city as will enable it to enlarge its scope and usefulness.

The conditions in each case of typhoid fever should be studied very carefully by the health department in order that preventive measures may be employed in the most effective manner and that any unusual condition, producing or threatening an epidemic of typhoid fever, may be discovered at the earliest possible moment. For this purpose every case should be visited, as soon as reported, by a representative of the health department, who should collect all information bearing on the possible source of infection. Constant and careful study of such data is essential to the conduct of a successful and economical campaign of prevention.

The death records of the city require a careful study not only in regard to typhoid fever but in regard to all other causes of death. These should be kept complete in such manner as to give the greatest possible information as to the health of the city and to be most readily available to all persons interested.

2. As a result of such a study of the sanitary conditions and causes of disease in the city, it should be the function of the board of health to recommend measures for the prevention of disease and to enforce obedience to such regulations. At present the health department is crippled, not so much for lack of authority or of proper statutes as for the lack of machinery to observe whether their ordinances are obeyed and to enforce obedience where it has been neglected.

In this connection attention has already been called to the necessity of having sanitary inspectors to observe conditions as regards sewage and garbage disposal and the sale of food supplies, and to enforce the ordinances relating thereto; also, to the necessity of having a dairy inspector to devote his whole time to this work.

3. Finally, a very important duty of the health department is to keep the public informed as to the prevalence of diseases and to educate them in measures necessary for their protection. Ignorance regarding the simplest principles of public health is responsible for as much if not more disease than is indifference. It is rare to find even well-educated people versed in the most elementary principles of the prevention of typhoid fever, for example. The distribution of literature by the city health department, sanitary instruction in the schools, and the use of newspapers for educational purposes would entail very little expense and would undoubtedly promote the efficiency of preventive measures, especially in the reduction of typhoid fever.

The results which may be attained in the prevention of disease by a fully equipped department of health are by no means purely speculative. To cite a single example: An admirable, energetic department of health was organized in Richmond, Va., in the year 1906. For 25 years prior to the organization of this department the city had had an average annual death rate of 77.4 per 100,000 from typhoid

fever. For the 4 full years 1907 to 1910, inclusive, in which this department has been in operation the average annual typhoid death rate has been 34.4 per 100,000—approximately one-half of what it had previously been. The effected reduction in the prevalence of this disease has been progressive, each year showing a death rate lower than that of the year preceding; and for the last year of this period (1910) the rate was 21.9 per 100,000—less than one-third of the rate which had for so many years been accepted as "usual" for that community. In this instance the reduction has been accomplished almost wholly by efforts directed toward preventing the spread of infection from sources within the city, by methods generally similar to those outlined above. The milk supply has been safeguarded by a careful inspection system. The water supply, however, remained, until the latter part of 1909, the same as for many years previously.

Many other examples could be cited as to the results accomplished by an effective health organization. Unfortunately, even more examples can be cited of disaster due to the lack of such organizations. It may be safely asserted that the most economical investment which any city can make is a liberal appropriation for the employment of the most efficient persons as guardians of the public health and for furnishing to them every facility to carry on their policies.

Even with the most perfect organization, however, the reduction of the prevalence of typhoid fever, in any community where it has long been prevalent, is a matter not of one but of many years' work. Efforts to this end should not be relaxed on the showing of a substantial reduction; on the contrary, they should be redoubled. When the number of cases has been reduced one-half, it is then possible with the same expenditure of money and time to pay twice as much attention to the prevention of further spread from these sources. It is only by such progressive increase of vigilance that the disease can finally be eradicated.